

Soil Monitoring Directive



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This directive provides the information required to carry out a soil monitoring program when that program is required by an approval issued under the Environmental Protection and Enhancement Act (EPEA). Sections A and D set out requirements for submitted proposals and reports, respectively. Section C describes acceptable options for identification and reporting of contamination. Finally, Section B describes requirements, options and defaults for execution of soil monitoring. Areas where flexibility exists are identified throughout the Directive.

In some cases monitoring will indicate that a soil management plan is needed. Guidance on developing and implementing a management program triggered by the soil monitoring program can be found in the "Guideline for Monitoring and Management of Soil Contamination Under EPEA Approvals".

A. Soil Monitoring Program Proposal Requirements

The following information must be supplied in the soil monitoring proposal:

- a) a schedule for the collection of soil samples;
- b) a short description of activities carried on at the facility;
- c) a short description of any changes to the site and operations since the last soil monitoring event;
- d) locations where chemicals and/or wastes are processed, stored and handled as indicated on a large scale aerial photograph, a large scale photomosaic, or a detailed map;
- e) locations from which samples will be collected as indicated on the photograph, photomosaic, or map;
- f) rationale for choice of the sampling locations;
- g) a list of facility-specific substances that will be analyzed;
- h) sampling procedures including depth increments and procedures for taking composite soil samples;
- i) analytical methodology; and
- j) a brief summary of any soil remediation or management activities previously undertaken.

B. Monitoring Procedures

B.1 Monitoring Locations

Areas of known soil contamination and areas at risk of contamination must be monitored. These include areas such as:

- a) areas known to be contaminated;
- b) product, raw material, treatment chemical, catalyst, or waste storage areas;

- c) process areas;
- d) chemical loading and unloading facilities, including loading docks;
- e) storage areas for new and out of service equipment that may be a source of soil contamination (e.g., transformers, vehicles, compressors, etc.);
- f) machinery servicing and maintenance areas;
- g) barrel storage areas;
- h) equipment (e.g., barrels, tanks, filters, vehicles, etc.) washing areas;
- i) unlined drainage ditches;
- j) above-ground chemical pipe racks; and
- k) any other areas where conditions or activities occur that are deemed to be a potential source of contamination.

Areas that are not contaminated beyond the applicable standards specified in the approval may be exempted from soil monitoring if they have been protected from potential contamination by adequate engineered controls such as housing, impermeable surfaces or liners, and containment and control facilities.

Facilities which are in operation and which are conducting soil monitoring for the first time must also obtain background soil samples from at least two sites. Background sites should have similar soil to that found on the site but must be unaffected by substances released from the site. *Where these conditions cannot be met, alternatives must be discussed and authorized in writing by the Contaminated Sites and Decommissioning Branch.*

Facilities which are conducting soil monitoring prior to commencing operation must sample enough locations to characterize the soil on their site but need not sample all the above locations. The number of locations necessary in this case will vary depending on the size of the site and whether different types of soil or fill occur within the site.

B.2 Sampling Procedures

Soil samples must be taken in such a manner that changes in contaminant concentration with depth are delineated. Satisfactory or default depth increments are: 0-15, 15-30, 30-60, 60-100 cm and, if contamination extends below 100 cm, in 50 cm increments until the maximum depth of contamination is reached. These depth increments may be changed if site-specific conditions warrant. *If the approval holder wishes to sample at different depth increments, they must present an adequate rationale for doing so in the soil monitoring proposal and receive authorization in writing from the Contaminated Sites and Decommissioning Branch.*

A single sample of each depth increment may be taken if the area being sampled is small and clearly defined. In less clearly defined areas composite samples shall be taken. A composite sample is a soil sample made up of at least two separate subsamples of similar mass taken from

the same sample depth at two or more locations within the same representative area. When acquiring, transporting and storing soil samples, procedures that avoid cross-contamination of samples and degradation or loss of substances shall be used. Details on appropriate procedures can be found in CCME (1993).

B.3 Analytical Requirements

When soil at a facility is monitored for the first time, the soil samples must be analyzed for:

- a) pH using the 0.01 M CaCl_2 method;
- b) electrical conductivity using the saturated paste method;
- c) cation exchange capacity;
- d) total soil organic carbon;
- e) particle size (percent sand, silt and clay) by the hydrometer method;
- f) sodium adsorption ratio;
- g) total trace elements by strong acid digestion; and
- h) other facility-specific substances.

When an approval holder has submitted adequate information on the above in a previous soil monitoring report, soil samples taken during subsequent monitoring events must be analyzed for:

- a) pH using the 0.01 M CaCl_2 method;
- b) electrical conductivity using the saturated paste method; and
- c) other facility-specific substances.

Facility-specific substances are those that may be present as a result of operations. They include substances such as:

- a) strong acid digestible trace elements such as barium, mercury, cadmium, molybdenum, chromium, nickel, cobalt, selenium, copper, vanadium, lead, and zinc;
- b) inorganics such as arsenic, boron, cyanide, and sulphur;
- c) hydrocarbons such as benzene, ethyl benzene, polycyclic aromatics, toluene, and xylenes;
- d) halogenated organics such as brominated or chlorinated sterilants, dioxins and furans, chlorobenzenes, chlorophenols, polychlorinated biphenyls, perchloroethylene and vinyl chloride; and
- e) toxic organic precursors, intermediates, products, byproducts, additives, catalysts or wastes such as methyl-t-butyl ether, dibenzothiophene, oxazolidone and glycols.

Screening parameters such as total petroleum hydrocarbons, mineral oil and grease, and biological toxicity test data (e.g., CCME 1996a) may be used in place of specific chemical analyses when appropriate. Justification for using screening parameters must be provided in the

soil monitoring proposal. The proposal must also describe benchmarks for each screening parameter at which the approval holder will proceed with remediation or further chemical characterization. Director's authorization must be obtained in writing for the proposed screening parameters and accompanying benchmarks.

Test methods used to analyze the soil samples must be obtained from the most recent version of Carter (1993), U.S. EPA (1986), and CCME (1993). *Alternative methods may be acceptable but must be authorized in writing by the Contaminated Sites and Decommissioning Branch before use.*

C. Soil Quality Standards

Soil quality standards shall be determined by either generic or site-specific standards according to the criteria below. Generic standards accepted by Alberta Environmental Protection are: the "Alberta Tier I Criteria for Contaminated Soil Assessment and Remediation" (AEP 1994), the "Canadian Soil Quality Guidelines for Contaminated Sites" or the "Interim Canadian Environmental Quality Criteria for Contaminated Sites" (Commercial/Industrial criteria only at qualifying sites) (CCME 1991). *Which of these is applicable at a given site is established under the soil monitoring proposal.*

C.1 Application of Generic Standards

For a given substance or parameter, generic standards shall be applied only at sites having the following characteristics:

- a) clay content in soil greater than five percent;
- b) soil pH between 6.0 and 8.5;
- c) seasonal water table no closer than one meter to the soil surface; and
- d) the ambient background concentration of a given substance does not exceed the standard.

C.2 Development of Site-Specific Standards

When a site or soil does not meet the conditions in C.1 or the soil is contaminated by a substance that is not included in the "Alberta Tier I Criteria for Contaminated Soil Assessment and Remediation" (AEP 1994), "Canadian Soil Quality Guidelines for Contaminated Sites" or "Interim Canadian Environmental Quality Criteria for Contaminated Sites" (CCME 1991), the standard for a given substance shall be:

- a) equal to the ambient background concentration of the substance; or
- b) derived using the CCME protocol (CCME 1996b); or
- c) adopted from another jurisdiction; or

- d) developed using site-specific risk assessment techniques.

Standards developed by these methods must be authorized in writing by the Director before they can be accepted as standards.

D. Soil Monitoring Summary Report Requirements

The following information must be supplied in the soil monitoring report:

- a) exact locations from which samples were collected as indicated on a large scale aerial photograph, a large scale aerial photo mosaic, or a detailed map;
- b) sampling site information including:
 - i) a description of each sampling site which may include surficial and internal drainage, slope and slope position;
 - ii) site alteration information where applicable, including depth to former soil surface now covered with fill; and
 - iii) facility processes and activities which may be affecting the sampling site;
- c) sampling increments;
- d) sampling and analytical methods;
- e) a comparison of results to background conditions as discussed in Section B.1;
- f) a tabular summary of analytical results;
- g) a summary of "Alberta Tier I Criteria for Assessment and Remediation of Contaminated Soils" (AEP 1994) exceedances;
- h) a summary of exceedances of the applicable standards if different than (g); and
- i) an interpretation of analytical results including an assessment of the need to:
 - i) prevent further contamination;
 - ii) further define and delineate contamination; and
 - iii) remediate or manage contaminated areas.

Note that QA/QC data must be collected and retained as per the Approval but need not be submitted with the report.

E. References

AEP. 1994. Alberta Tier I Criteria for Assessment and Remediation of Contaminated Soils. Alberta Environmental Protection, Chemicals Assessment and Management Division.

Carter, M. (ed.) 1993. Soil Sampling and Methods of Analysis. Lewis Publishers. Boca Raton, Florida.

CCME. 1991. Interim Canadian Environmental Quality Criteria for Contaminated Sites.

Canadian Council of Ministers of the Environment. CCME EPC-CS34. Winnipeg, Manitoba.

CCME. 1993. Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites. Vols. I and II. Canadian Council of Ministers of the Environment. CCME-EPC-NCS-62 and 66E. Winnipeg, Manitoba.

CCME. 1996a. Application of Recommended Whole Organism Bioassays in the Assessment of Contaminated Sites in Canada. Canadian Council of Ministers of the Environment. *In press*.

CCME. 1996b. Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada. Canadian Council of Ministers of the Environment. En 108-4/9-1996E.

U.S. EPA. 1986. Test Methods for Evaluating Solid Waste. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.